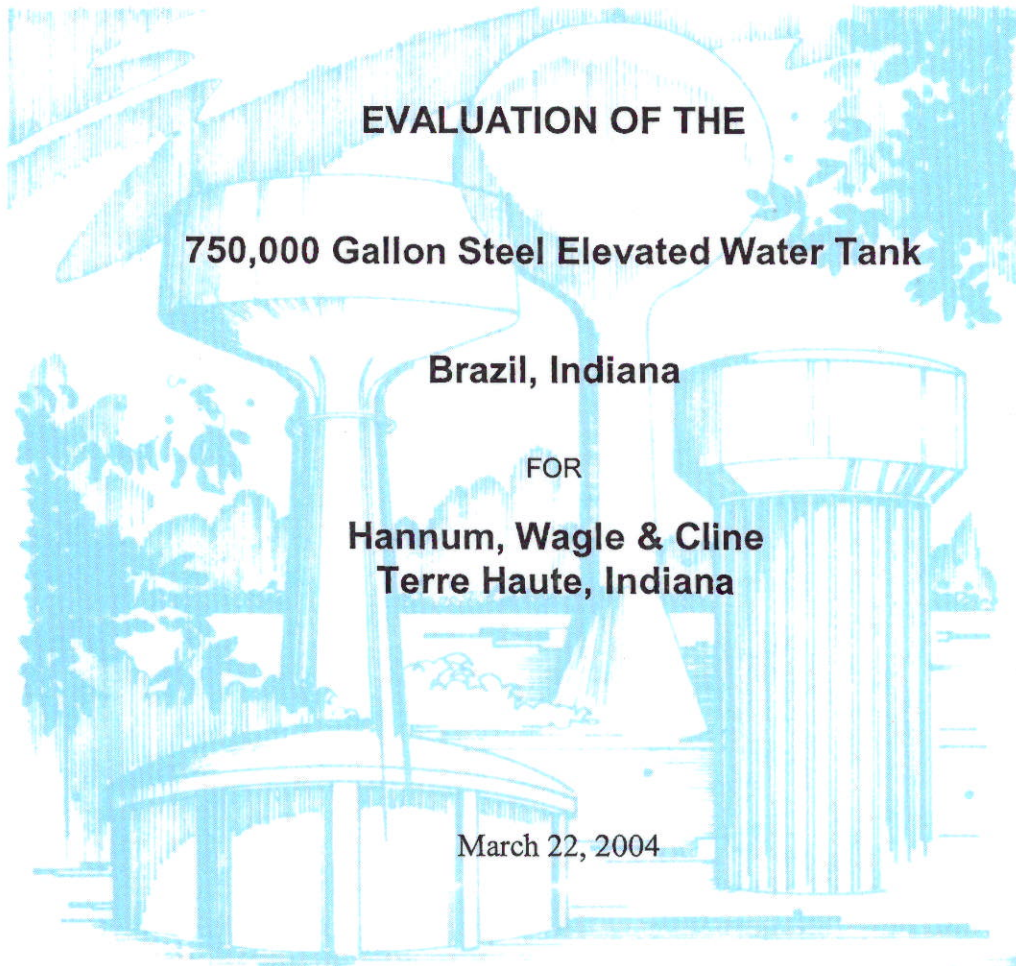


TANK INDUSTRY CONSULTANTS



EVALUATION OF THE

750,000 Gallon Steel Elevated Water Tank

Brazil, Indiana

FOR

Hannum, Wagle & Cline
Terre Haute, Indiana

March 22, 2004

04.002.H969.01

TM

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April 8, 2004

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SUBJECT:

The subject of this report is the field evaluation of the 750,000 gallon steel elevated water tank in Brazil, Indiana. The tank was owned by the City of Brazil. The field evaluation was performed on March 22, 2004 by Paul A. Troemner, P.E. and James A. Peyer of Tank Industry Consultants. The Owner's representatives on the site at the time of the field evaluation were Brian Pohlar, P.E., John Ray, and Jake Roebuck. The double-ellipsoidal tank was of welded steel construction. According to information on the tank nameplate, the tank was built in 1956 by Pittsburgh-Des Moines Steel Company, and had a capacity of 750,000 gallons. The tank nameplate also stated that the 8-column tank was 122 ft to top capacity level and 85 ft to bottom capacity level.

OBJECTIVE:

The purpose of this washout and evaluation was to determine the condition of the tank interior, exterior, exposed foundations, and accessories. The purpose of this report is to present the findings of the evaluation and to make recommendations for recoating, repairing, corrosion protection, and maintenance. Budget estimates for the work, anticipated life of the coating and the structure, and the replacement cost of the tank are also included.

AUTHORIZATION:

This washout, evaluation, disinfection, and report were authorized in the Standard Form of Agreement between Tank Industry Consultants and the City of Brazil signed by Mayor Thomas Arthur and dated February 16, 2004.

SUMMARY:

Exterior Coating: The exterior coating system appeared to be in very poor condition. Tank Industry Consultants believes that the exterior of the container and tower surfaces should be painted within the year from a corrosion standpoint. Due to widespread coating failures and very poor adhesion of the remaining exterior coating, topcoating does not appear to be a feasible option.

Interior Coating: Due to the significant amount of rust in the roof structure and the few severe pits observed in the bowl, Tank Industry Consultants recommends that the interior surfaces of this tank should be recoated within the year. It is recommended that when the interior is completely cleaned and repainted, an epoxy coating system should be used.

ANSI/OSHA and Safety-Related Deficiencies: There were OSHA and safety-related deficiencies on this tank. These deficiencies included:

- ◆ severe corrosion and metal loss were observed on the interior container ladder brackets and rungs,
- ◆ the interior container ladder was not equipped with a safe-climbing device,
- ◆ the vault rungs, interior container ladder, and exterior ladders were not dimensionally compliant,
- ◆ the rungs of the interior container ladder and exterior ladders were not of a slip-resistant design,
- ◆ the revolving-type shell and roof ladder was supported by a single-point of attachment,
- ◆ the shell and roof ladder safe-climbing device was not properly installed,
- ◆ the rust and paint on the safe-climbing devices may not allow the devices to function properly,
- ◆ the tower ladder was not equipped with a vandal deterrent,
- ◆ a conduit and a cable were attached to the exterior ladders which could interfere with the unrestricted use of the side rails by the climber,
- ◆ the balcony safety railing was not dimensionally compliant, and
- ◆ two exposed splices of electrical wires for the obstruction light were located on the roof.

If the Owner wishes to fully comply with OSHA and safety-related standards, it is recommended that these deficiencies be rectified.

AWWA and Operational Deficiencies: There were sanitary and operating deficiencies on this tank as well. These deficiencies included:

- ◆ the roof vent was not of a clog-resistant design,
- ◆ the sections of protective screening on the roof vent were not restrictive enough to prevent the ingress of insects into the tank,
- ◆ gaps between the screen and the vent neck would not prevent the ingress of insects into the tank,
- ◆ corrosion had created holes in the roof along the curb of the roof manhole which would allow the ingress of insects and precipitation into the tank, and
- ◆ the discharge end of the overflow pipe was not equipped with adequate protective screening or a flap gate.

These deficiencies should be corrected.

The safety-related, sanitary, and operating deficiencies listed above are not intended to be a complete list of deficiencies on this tank. The Owner should refer to the complete report text and accompanying photographs for a complete account of all observed deficiencies.

This evaluation and the reporting of the condition of this tank do not warrant the original structural condition of the tank or any of the original design for seismic loadings. Likewise, recommendations for this tank do not include modifications which may be required for compliance with present structural codes.

PHOTOGRAPHS:

Color photographs were taken of the visible portions of the foundations, the tank interior and exterior and are included as a part of this report. The significant photographs are keyed to the observations.

NOMENCLATURE:

The terms used in describing the various components of steel water tanks are unique to the industry. In fact, the terms vary from firm to firm and from person to person. In an attempt to define the terms used in this report, a sketch of the general type of tank covered is included at the end of the narrative portion of this report. Also, to aid in reference to the columns, the ladder column is referred to as column 1 and the remaining 7 columns are numbered clockwise. **Warning: Some appurtenances on this tank may be referred to as erection or rigging attachments, lugs, or brackets. This does not mean that they are safe for rigging. Each attachment for each tank should be evaluated on an individual basis by a structural engineer or an experienced rigger before being used. These devices may have been intended for only the original erectors and painters to use with specialized equipment.**

ADHESION TESTS:

All adhesion tests performed during this evaluation were done in general accordance with ASTM D3359. The results are reported herein using the ASTM scale. The ASTM scale is a relative scale to rate adhesion from 0 to 5 with 5 being the best. A table of adhesion test results classification is included with this report following the sketch of the tank.

HEAVY METALS TESTS:

Samples of the exterior and interior coating systems were sent to a laboratory for atomic absorption analyses. The test results were as follows:

	Cadmium		Chromium		Lead	
	mg/kg	percent	mg/kg	percent	mg/kg	percent
Exterior Bowl	<25	<0.0025%	399	0.0399%	26,500	2.65%
Interior Bowl	<25	<0.0025%	2,600	0.26%	42,500	4.25%

Tank Industry Consultants performs this test only to determine if there is lead, cadmium, or chromium present in the coating samples. To limit damage to the existing coating, only small areas were tested. The small number of samples taken and the difficulty of retrieving all primer from the steel profile may cause the tests performed to not accurately represent the total coating system. Variations in thickness, types of coatings applied, and the interim cleaning and painting operations will also affect the actual readings. The reliability of the results is also dependent on the amount of primer included in the sample. The Consumer Product Safety Commission specifies that an amount greater than 0.06% lead is considered potentially hazardous. Additional testing to determine the amount of leachable contaminants present in the spent cleaning debris will need to be performed following cleaning operations at the time of repainting. Results from the laboratory analysis are included following the adhesion tables.

ULTRASONIC THICKNESS MEASUREMENTS:

Roof:	(all readings were taken through coating)
Cap:	0.268 in. to 0.270 in.
Top Finger:	0.187 in. to 0.189 in.
Bottom Finger:	0.200 in. to 0.203 in.
Knuckle:	0.244 in. to 0.246 in.
Shell:	0.491 in. to 0.493 in.
Balcony Floor:	0.339 in. to 0.341 in.
Bowl:	
Knuckle:	0.525 in. to 0.531 in.
Finger:	0.431 in. to 0.433 in.
Saucer:	0.533 in. to 0.534 in.
Riser:	
Top Can:	0.648 in.
Second From Top Can:	0.380 in.
Bottom Can:	0.373 in. to 0.377 in.
Base Plate:	0.640 in. to 0.646 in.
Column:	
Top Can:	0.697 in. to 0.700 in.
Bottom Can:	0.599 in. to 0.603 in.
Base Plate:	2.061 in. to 2.066 in.

OBSERVATIONS:

A. Foundations and Site

SITE:

Size: approx. 157 ft x 132 ft

Fence:

Type: chain link, with 3 strands of barbed wire angled inward

Height: 4 ft

Gate:

Location: north side of site

Width: 12 ft

Locked: yes

Nearest Structures:

Type: telemetry building

Direction: west of riser

Distance: approx. 22 in. from riser

Type: garage

Direction: south

Distance: approx. 37 ft

Nearest Overhead Power Lines:

Direction: electrical line extends underneath tank to telemetry building adjacent to riser

Direction: southwest

Distance: approx. 16 ft

FOUNDATIONS:

Number: 8 columns, 1 riser

Size:

Column: 4 ft 4 in. x 4 ft 4 in.

Riser: 9 ft x 9 ft

Sealant: none

Grout: none

Column Number:	Projection Above Grade:
1	11 in. to 12 in.
2	13 in.
3	15 in. to 16 in.
4	16 in. to 17 in.
5	15 in. to 16 in.
6	12 in. to 13 in.
7	10 in. to 12 in.
8	11 in. to 12 in.
Riser	11 in. to 12 in.

VAULT:

Location: approx. 12 ft north of riser

Size: approx. 4 ft diameter x 6 ft 10 in. deep

Access:

Size: 20-3/4 in. diameter

Locked: no, iron manhole cover

Rungs:

Number: 3

Size: 1 in. square

Spacing: approx. 16 in. on centers

Width: 9 in.

Toe Room: 5 in.

Head Clearance: approx. 16 in.

1. **Site Location:** The tank was located near the intersection of Vandalia Street and Midland Street in Brazil, Indiana. The tank site was located in a residential neighborhood. The nearest building to the tank site was a garage located south of the site. (See photos 1-6)

2. **Site Conditions:** The tank site was covered with grass and appeared to be graded to provide adequate drainage away from the foundations. The tank site was fenced. The chain link fence was topped with barbed wire and was equipped with a double gate on the north side of the site. The barbed wire was angled inward at the top of the fence. Some broken strands of barbed wire were noted at the southwest corner, southeast corner, and approximate center of the south side of the site. Overhead power lines were located southwest of the tank and at light poles south and north-northwest of the tank. An overhead electrical line extended underneath the tank to a telemetry building adjacent to the riser. (See photos 7-8, 15-16, 29)

3. **Foundations:** Cracking and hollow sounding areas were observed in the exposed surfaces of the foundations at the time of this field evaluation. The top approximately 2 in. cap of the foundations for column #4, column #5, and the riser appeared to be delaminated concrete. The tops of the foundations generally met or exceeded the AWWA recommended projection of 6 in. to 12 in. above grade. A gray coating was visible on portions of the exposed concrete surfaces. There was no grout or sealant visible at the concrete foundation-to-base plate interfaces. (See photos 11-13)

4. **Vault:** There were safety and OSHA deficiencies noted: (1) the rung width of 9 in. did not meet the required 16 in. minimum, (2) the 5 in. toe room did not meet the required 7 in. minimum, (3) the ladder rungs were not all spaced at consistent 12 in. intervals, and (4) the head clearance at the vault access did not meet the required 30 in. minimum. There was a vault located north of the riser. Access into the vault was not locked prior to or after this field evaluation. The access was equipped with an iron cover. The vault contained a tap into the inlet/outlet pipe for the telemetry located inside the building west of the riser. Water was observed in the bottom of the vault. Valve boxes were also located on site. (See photos 9-10)

B. Exterior Tower and Container

DESCRIPTION:

Construction: welded steel
Columns: 8
Tower: 3 bays
Bowl: ellipsoidal
Shell:
 Diameter: approx. 65 ft
 Shell Height: 5 ft 11 in.
Roof: ellipsoidal

NAMEPLATE:

Location: above riser manhole

**PITTSBURGH-DES MOINES
STEEL COMPANY**

**ERECTED 1956
CAPACITY 750,00 GALLONS
HEIGHT 122'-0" TO UPPER CAPACITY LEVEL
85'-0" TO LOWER CAPACITY LEVEL**

COLUMNS:

Type: tubular
Size: approx. 32 in. diameter
Base Plate: octagonal with 18-1/2 in. and 19 in. sides
Anchor Bolts:
 Number Per Column: 2
 Size: 1-5/8 in. diameter

RISER:

Diameter: approx. 8 ft
Base Plate: octagonal with 32-1/2 in. and 52 in. sides
Anchor Bolts:
 Number: 4
 Size: 1 in. diameter

RISER MANHOLE:

Type: single-crab
Size: 16 in. diameter
Neck:
 Size: 6 in. x 5/8 in.
 Exterior Projection: 1 in. at vertical centerline
Cover:
 Size: 17-3/4 in. diameter x 3/4 in. thick
 Hinged: no
Bolt Size: 1 in. diameter x 8 in. long

DIAGONAL BRACING:

Bottom Bay:
 Rod Diameter: 1-3/4 in. (upset to 2-1/8 in.)
 Wing Plate: 15-1/2 in. x 7-1/2 in. x 3/4 in. thick
Middle Bay:
 Rod Diameter: 1-3/8 in. (upset to 1-3/4 in.)
 Wing Plate: 35-1/2 in. x 7-1/2 in. x 5/8 in. thick
Top Bay:
 Rod Diameter: 1-3/8 in. (upset to 1-3/4 in.)
 Wing Plate: 35 in. x 7-1/2 in. x 7/16 in. thick
Rod Pin Size: 2-1/8 in. diameter x 3-1/2 in. long

RISER RODS:

Bottom Level Size: 1 in. diameter
Top Level Size: 1 in. diameter
Rod Pin Size: 3/4 in. diameter x 2-1/2 in. long

STRUTS:

Type: 2 channels intermittently welded together to form a "T" shape
Channel Size: 6 in. x 2 in.
Connection: bolted and welded to wing plates
Bolts:
 Number: 2
 Size: 1 in. diameter x 2-1/2 in. long

OVERFLOW PIPE:

Size: 6 in. diameter
Visible Air Break: yes, approx. 40 in.
Protective Screen: none
Brackets:
 Size: 4 in. x 1/4 in., flat bar x 6 in. long
 Spacing: approx. 12 ft
Drain Basin: 6 ft x 4 ft x 2 ft 9 in. deep (15 in. projection above grade)
 with 12 in. diameter tile drain pipe

TOWER LADDER:

Number of Rungs: 89
Distance From Foundation to Lowest Rung: approx. 12 ft 10 in.
Width: 15 in.
Side Rails: 2 in. x 5/16 in., flat bar
Rung Size: 5/8 in. diameter
Spacing: 12 in. on center
Toe Room: 6 in.
Head Clearance at Balcony: approx. 19 in.
Brackets:
 Construction: welded to column and bolted to ladder w/ 3/4 in. diameter bolts
 Size: 4 in. x 1/4 in., flat bar x 10 in. long
 Spacing: approx. 12 ft
Safe-Climbing Device: notched-tubular rail
Vandal Deterrent: none

BALCONY:

Width: 29-1/2 in.
Handrail:
 Height: 35-3/4 in.
 Size: 2-1/2 in. x 2 in. x 1/4 in., angle
Diagonal Bracing: 2 in. x 2 in. x 3/16 in., angle
Toe Bar:
 Size: 10 in. x 1/2 in., flat bar
 Height Above Floor: 4-3/4 in.
Access Opening: approx. 24 in. diameter (21 in. depth)

SHELL AND ROOF LADDER:

Number of Rungs: 46
Type: revolving
Side Rails: 3-1/2 in. x 1-1/2 in. x 1/4 in., angle
Width: 15 in.
Rung Size: 5/8 in. diameter
Spacing: 12 in. on center
Toe Room: 5 in.
Safe-Climbing Device: notched-tubular rail

ROOF OPENINGS:

Manhole:
 Size: 24 in. diameter
 Type: hinged
 Curb: 4 in.
 Welded: exterior only
 Overlap: 2 in.
 Locked: yes

Roof Vent:

Neck Height: 8 in.

Neck Diameter: approx. 36 in. diameter

Screen:

Orientation: horizontal

Size: 16 x 16 mesh and patches of 4 x 4 mesh

Cover: 5 ft 6 in. diameter

ROOF OBSTRUCTION LIGHTS:

Type: double-globe

Location: on roof vent

Manufacturer: Crouse-Hinds

Model Number: AN 2547-B

Operational: no, one bulb missing and other bulb missing filament

Photoelectric Cell:

Location: on column below tower ladder

Orientation: south

EXTERIOR COATING AND METAL CONDITION:

	Coating Thickness		Approx. % Failure to		Adhesion	Metal Loss	
	Range	Typical	Primer	Rust		Typical	Deepest
Columns	7 mils to 14 mils	9 mils	20%	1%	4 S	Neg.	<1/32 in.
Riser	2 mils to 17 mils	6 mils	Neg.	20%	0 T	<1/16 in.	3/32 in.
Diagonal Bracing	4 mils to 9 mils	6 mils	3%	5%	0 T	Neg.	Neg.
Riser Rods	4.5 mils to 14 mils	8.5 mils	2%	10%	-	Neg.	Neg.
Struts	6 mils to 18 mils	12 mils	10%	5%	0 T	<1/16 in.	1/16 in.
Bowl	6.5 mils to 10 mils	7.5 mils	10%	20%	0 T	<1/16 in.	1/16 in.
Balcony	7.5 mils to 19 mils	10 mils	10%	20%	0 T	<1/16 in.	1/16 in.
Shell	4.5 mils to 6.5 mils	5 mils	5%	10%	0 T	Neg.	Neg.
Roof	4 mils to 8 mils	5 mils	20%	20%	0 T	<1/16 in.	1/16 in.

Key to Table

Adhesion 5 (very good)
4 (good)
3 (fair)
2 (poor)
1 (very poor)
0 (very poor)

T = Topcoat to Underlying Coating

S = Primer to Steel

Neg. = negligible

1. **Exterior Coating Condition:** The coating on the exterior of the tower and container appeared to be in very poor condition. The exterior coating exhibited very poor adhesion to the underlying coating and the steel. The coating appeared to be an alkyd coating system.

2. **Base Plates:** The column and riser base plates appeared to be in adequate overall condition at the time of the field evaluation. Widespread coating failures and rust were observed on the base plates. (See photos 11-13)

3. **Anchor Bolts:** Each of the columns was equipped with two anchor bolts, and the riser was equipped with four anchor bolts. Pack rust was noted on washers and at the bottom of nuts. (See photos 11-13)

4. **Column Condition:** The columns were of welded steel construction and appeared to be in nearly their original structural condition at the time of the field evaluation. Widespread coating failure to the underlying coating and large areas of rust were observed on the columns. An abandoned cathodic protection system control cabinet was located near the bottom of column #1. There were hand holds located on the columns above the struts and directly beneath the bowl. **It is the opinion of Tank Industry Consultants that the hand holds should not be used for rigging purposes or personnel access.** (See photos 18-24)

5. **Riser Condition:** The riser was of welded construction. The riser exterior appeared to be in nearly its original structural condition at the time of the field evaluation. Significant coating failure to rust and rust staining were observed on the riser. An overhead electrical line for the telemetry building west of the riser was in contact with the riser. The tank nameplate and a hose bib were located near the bottom of riser. The riser was equipped with a single-crab manhole. The riser around the manhole was not equipped with a reinforcing plate. The riser manhole cover was equipped with a hinged support on the interior. (See photos 13-15, 28-30)

6. **Diagonal Bracing:** The coating system on the diagonal bracing appeared to be in very poor overall condition at the time of the field evaluation. The diagonal bracing rods were upset on the ends. The diagonal bracing was equipped with turnbuckles, clevises, and wing plates. Coating failures and rust were observed on the rods, turnbuckles, and inside the clevises. Rust staining was noted at the clevis connections to the wing plates. (See photos 22-27)

7. **Riser Rods:** The tower was equipped with two sets of riser rods which were located at the strut levels. It appeared that a third level of riser rods just below the bowl had been removed. The riser rods were bolted through angles located around the riser. Surface rust was observed on the rods. **It is the opinion of Tank Industry Consultants that the riser rods should not be used for rigging purposes or personnel access.** (See photo 28)

8. **Struts:** The tower was equipped with two sets of struts. The struts were bolted and welded to the wing plates. Coating failure and significant rust were observed on the struts. The struts were equipped with drain holes. (See photos 22-26)

9. **Overflow Pipe:** **There was a sanitary deficiency noted: the discharge end of the overflow pipe was not equipped with adequate protective screening or a flap gate.** The overflow pipe exited through the bowl knuckle and extended down the column to near grade. The overflow pipe was equipped with a base elbow and thrust block at the column foundation. The overflow pipe then extended to and discharge in a drain basin on site. The overflow pipe was equipped with an above-ground air break. The pipe was equipped with welded steel brackets. (See photos 17-18)

10. **Tower Ladder:** There were safety and OSHA deficiencies noted: (1) the rust and paint on the safe-climbing device may not allow the device to function properly, (2) the width between side rails of 15 in. did not meet the required 16 in. minimum, (3) the 6 in. toe room did not meet the required 7 in. minimum, (4) the 2 in. x 5/16 in. side rails did not meet the required minimum of 2-1/2 in. x 3/8 in. side rails, (5) the 5/8 in. diameter ladder rungs did not meet the required minimum ladder rung diameter of 3/4 in., (6) the rungs were not of a slip-resistant design, (7) the ladder was not equipped with a vandal deterrent, (8) a conduit and a cable were attached to the ladder brackets which could interfere with the unrestricted use of the side rails by the climber, and (9) the 19 in. head clearance at the balcony access did not meet the required 30 in. minimum. The tower was equipped with a ladder which provided access from near grade to the balcony. The tower ladder was equipped with a notched-tubular safe-climbing device. The tower ladder was bolted to brackets which were welded to the column. The tower ladder and brackets appeared to be in nearly their original structural condition at the time of this field evaluation. (See photos 33-36)

11. **Bowl Condition:** The coating on the bowl surfaces appeared to be providing very poor overall corrosion protection. Large areas of coating failure and rust were observed. (See photos 30-32)

12. **Balcony Condition:** There were safety and OSHA deficiencies noted: (1) the 35-3/4 in. handrail height did not meet the required 42 in. minimum, (2) the safety railing was not equipped with a mid-rail, and (3) the 2 in. x 2 in. x 3/16 in. diagonal bracing did not comply with the required 2 in. x 2 in. x 3/8 in. Access to the balcony from the tower ladder was through an opening in the balcony floor. An angle was installed on the balcony adjacent to the opening in the floor to prevent personnel from walking directly into the opening. The access width on the balcony between this angle and the shell was approximately 12 in. The balcony floor was equipped with drain holes; however, evidence of trapped water was found on the balcony near the shell and toe bar. The underside of the balcony floor was intermittently welded to the shell and toe bar. The safety railing was of welded and bolted construction. Widespread coating failures and rust were observed on the balcony floor. (See photos 36-39)

13. **Shell Condition:** The contour of the tank shell appeared to be good as no significant discontinuities were observed at the time of this field evaluation. Significant chalking, peeled topcoat, and areas of rust were observed on the shell. Scratches were noted in the shell coating from the wheels of the revolving shell and roof ladder. A circular welded steel patch plate was located in the northwest side of the shell. (See photos 39-42)

14. **Signs:** There were company names in approximately 5 in. wide letters painted vertically on each column and on the east side of the riser. "BRAZIL" in approximately 4 ft tall letters was painted on the south side of the shell. "HOME OF THE FIGHTING RED DEVILS" in approximately 6 in. wide letters and "TOWN OF PROGRESS" in approximately 9 in. wide letters were painted on the shell. "PROGRESS" was misspelled, missing an "R," in this sign on the east side of the shell. "BRAZIL IND." and "AIRPORT 3 MI." with an arrow had been painted on the roof of the tank. The signs were in black letters. The signs had faded. (See photos 1-2, 18, 31-32, 40, 42, 50)

15. **Exterior Shell and Roof Ladders:** There were safety and OSHA deficiencies noted: (1) the rust on the safe-climbing device may not allow the device to function properly, (2) the 13 ft or greater spacing of the safe-climbing device clamps did not meet the manufacturer's recommendation, (3) the revolving-type shell and roof ladder was supported by a single-point of

attachment, (4) the width between side rails of 15 in. did not meet the required 16 in. minimum, (5) the 5 in. toe room did not meet the required 7 in. minimum, (6) the 5/8 in. diameter ladder rungs did not meet the required minimum ladder rung diameter of 3/4 in., (7) the rungs were not of a slip-resistant design, and (8) a conduit and a cable were attached to the ladder side rail which could interfere with the unrestricted use of the side rail by the climber. The revolving shell and roof ladder was attached to the roof vent neck with a yoke bracket. The ladder was equipped with a notched-tubular safe-climbing device. Widespread surface rust was observed on the safe-climbing device. (See photos 38, 47-48)

16. Roof Condition: The contour of the roof appeared to be adequate at the time of this evaluation. The coating on the roof had experienced significant chalking and erosion exposing the underlying coating. Large areas of rust were observed on the roof. There were approximately seventy 2 in. diameter couplings located in the roof plates. Approximately 9 cathodic protection anode hand holes and cover plates were located in the roof plates. One of the cover plates was welded to the roof. (See photos 44-50)

17. Obstruction Lights: There was a safety deficiency noted: **two exposed splices of electrical wires for the obstruction light were located on the roof.** The roof was equipped with a double-globe obstruction light mounted on the roof vent. The obstruction light was equipped with a photoelectric cell that was mounted on the column below the tower ladder, facing south. The obstruction light was not illuminated at the time of this field evaluation. One bulb for the obstruction light was missing and the other bulb appeared to be missing its filament. (See photos 48, 50)

18. Roof Manhole: There was a sanitary deficiency noted: **corrosion had created holes in the roof along the curb of the roof manhole which would allow the ingress of insects and precipitation into the tank.** The roof was equipped with one manhole. The manhole was equipped with a hinged and locked cover. The existing lock was cut off prior to the field evaluation and a new lock provided by the Owner was installed after the field evaluation. The roof manhole was welded on the exterior only. (See photo 46)

19. Roof Vent: There were sanitary and operational deficiencies noted: **(1) the roof vent was not of a clog-resistant design, (2) the sections of 4 x 4 mesh protective screening on the roof vent were not restrictive enough to prevent the ingress of insects into the tank, and (3) gaps between the screen and the vent neck would not prevent the ingress of insects into the tank.** The roof was equipped with a vent in the approximate center of the roof. Sections of 4 x 4 mesh screen had been used to patch holes in the 16 x 16 mesh vent screen. An antenna mounting bracket, but no antenna, was located on the roof vent cover. A cathodic protection hand hole was located in the vent cover. (See photos 48-50)

C. Interior Container and Riser

ROOF SUPPORT SYSTEM:

Trusses:

Number: 15

Sizes:

Top Member: approx. 5-1/4 in. x 4 in. x 1/2 in., tee

Bottom Chord and Other Members: approx. 2-1/2 in. x 2-1/2 in. x 3/8 in., angle

Knuckle Stiffeners:

Number: 15

Size: approx. 5 in. x 3-1/2 in. x 3/8 in., angle

Center Hub: approx. 6 ft diameter constructed from two 4 in. x 4 in. x 1/4 in., angles

INTERIOR SHELL STIFFENER:

Size: approx. 6 in. x 1/2 in., flat bar

Construction: intermittently welded to top of shell

INTERIOR CONTAINER LADDER:

Number of Rungs: 40

Width: 15-3/4 in.

Rung Size: 5/8 in. diameter

Spacing: 12 in. on center

Side Rails: 2 in. x 1/4 in., flat bar

Toe Room: greater than 7 in.

Head Clearance: 22 in.

Brackets:

Construction: welded

Size: 2 in. x 2 in. x 3/16 in., angles

Spacing: approx. 16 ft

Safe-Climbing Device: none

CATHODIC PROTECTION: none, has been removed.

OVERFLOW:

Inlet Type: weir box

Location: approx. 2 in. below the roof knuckle-to-finger connection

RISER SAFETY GRATE:

Riser Opening: 30 in. diameter

Grate Openings Size: 9 in. x 7 in.

Construction: 2-1/2 in. x 3/8 in., flat bars and 1 in. x 3/8 in., flat bars

Hinged: yes

INLET/OUTLET PIPE:

Size: 18 in. diameter
Projection: 36 in. above riser floor
Protective Cover: none

INTERIOR COATING AND METAL CONDITION:

	Coating Thickness		Approx. % Failure to		Adhesion	Metal Loss	
	Range	Typical	Primer	Rust		Typical	Deepest
Roof	5.5 mils to 12 mils	6 mils	Neg.	6%	3 S	Neg.	Neg.
Shell	6.5 mils to 15 mils	-	Neg.	10% fluctuation zone 1/2% lower shell	4 T	Neg.	Neg.
Bowl	16 mils to 20 mils	-	Neg.	1/2%	0 S	Neg.	13/32 in.
Riser	3.5 mils to 12 mils	6.5 mils	Neg.	Neg.	5 S	Neg.	Neg.

Key to Table

Adhesion 5 (very good) T = Topcoat to Underlying Coating Neg. = negligible
 4 (good)
 3 (fair) S = Primer to Steel
 2 (poor)
 1 (very poor)
 0 (very poor)

1. **General Interior Coating Condition:** The coating on the interior surfaces of the tank appeared to be in generally poor condition. Significant corrosion and metal loss were observed on the roof structure. Isolated coating failures on the bowl around the riser opening had allowed significant pitting to occur. The interior coating appeared to be an epoxy coating system.

2. **Roof Condition:** The coating on the roof plates and roof structure appeared to be in very poor condition. The interior roof support structure consisted of radial roof trusses and intermittently welded stiffeners on the roof knuckle. The inner ends of the roof trusses were bolted to clips welded to a center hub. The outer ends of the roof trusses were bolted to plates welded to the roof knuckle stiffeners. Corrosion and metal loss were observed along the truss members and at the bolted connections. Wiring for a cathodic protection system was located in the roof of the tank. There were no anodes in the tank at the time of this field evaluation. (See photos 51-64)

3. **Shell Condition:** The coating at the top of the interior shell in the fluctuation zone appeared to be in poor condition. The coating on the lower majority of the interior shell appeared to be in fair condition. The shell coating was discolored due to mineral staining from the water. An intermittently welded stiffener was located around the top of the shell. Column post head stiffeners were located on the interior shell. (See photos 63-66, 69, 72)

4. **Interior Container Ladder:** There were safety and OSHA deficiencies noted: (1) severe corrosion and metal loss were observed on the ladder brackets and rungs, (2) the ladder was not equipped with a safe-climbing device, (3) the width between side rails of 15-3/4 in. did not meet the required 16 in. minimum, (4) the 22 in. head clearance at the roof manhole did not meet the required 30 in. minimum, (5) the 2 in. x 1/4 in. side rails did not meet the required minimum of 2-1/2 in. x 3/8 in. side rails, (6) the 5/8 in. diameter ladder rungs did not meet the required minimum ladder rung diameter of 3/4 in., and (7) the rungs were not of a slip-resistant

design. The interior container ladder was welded to brackets which were welded to the shell. The interior container ladder and brackets appeared to be in poor structural condition at the time of this field evaluation. Each set of ladder brackets had one diagonal support. Significant metal loss and holes were observed in the bottom set of brackets. The top rungs of the ladder had experienced metal loss up to half the diameter of the rung. **Due to the significant corrosion and metal loss on the existing interior container ladder, personnel should not use the existing interior container ladder for access.** (See photos 68-71)

5. **Overflow Pipe:** The overflow pipe was equipped with a weir box inlet. The location of the overflow inlet was such that the top capacity level was approximately level with the roof knuckle-to-roof finger connection. (See photos 65-66)

6. **Bowl Condition:** Isolated coating failures on the bowl in the area of the riser-to-bowl connection had allowed significant pitting to occur. The spot coating failures had resulted in pit depths of up to 13/32 in. A random cluster of blisters was noted on the interior bowl. The coating on the rest of the bowl appeared to be in generally fair condition. A hinged safety grate was located over the riser opening in the bowl. (See photos 72-83)

7. **Riser Condition:** The coating on the interior of the riser cans appeared to be in generally fair condition. Random pinhole rust was noted in the riser. Significant blistering was observed in the coating on the floor of the riser. Brackets and lugs were located inside the riser and at the floor of the riser. **It is the opinion of Tank Industry Consultants that the lugs and brackets in the riser should not be used for rigging purposes or personnel access.** (See photos 83-90)

8. **Riser Piping:** The inlet/outlet pipe was located in the base of the riser. The inlet/outlet pipe projected 36 in. above the riser base plate. The inlet/outlet pipe was not equipped with a protective cover. It appeared as though the inlet/outlet pipe contained a lead joint at the base plate penetration. (See photos 88-90)

RECOMMENDATIONS:

A. Foundations and Site

1. **Site Maintenance:** The site should be maintained so that the top of all foundations project a minimum of 6 in. to a maximum of 12 in. above grade and so that proper drainage away from the foundations continues. Site maintenance should be performed with the mower discharge directed away from the base of the tank to prevent rock chips in the coating and the accumulation of grass on the base plates. Any damaged barbed wire on the fencing should be repaired or replaced. The gate should continue to be locked at all times to deter unauthorized entry and limit liability for the Owner.

2. **Tank and Site Security:** Water tanks have been defined by some courts under certain circumstances as attractive nuisances. As such, there may be a significant potential liability to the Owner for injury to persons on the tank and tank site, even if access is not authorized. Recent events have prompted the entire water industry to consider measures that inhibit intentional acts that could threaten the water supply. A review of the security requirements for the tank and site is recommended to confirm that the existing measures are consistent with the Owner's security requirements for their water system. Primary tank and site security should be focused on eliminating, preventing, and

detecting unauthorized access to the tank. Such security measures might include routinely and periodically verifying all hatches and gates are locked, and all exterior ladders have suitable deterrents. Other security measures might include improving the fence by raising the height and/or angling strands of barbed wire outward, upgrading the existing site lighting, adding motion detectors on the site, installing surveillance cameras, installing alarms on gates, doors, and tank hatches, and arranging more frequent site visits by law enforcement agencies.

3. **Foundations:** When the tank exterior is repainted, any unsound concrete should be chipped to sound material and the concrete should be brush-off blasted. Any reinforcing steel thus exposed should be cleaned prior to repairing the concrete. Any deteriorated areas or voids found should have a bonding agent and a vinyl emollient modified concrete patching mortar applied to build up the surface to its original contour. The concrete should then be painted with a concrete sealer. Any gap between the steel base plates and the concrete should be filled with a flexible sealant.

4. **Overhead Power Lines:** All overhead power lines within 40 ft of the tank, including that extending under the tank to the telemetry building, should be relocated underground in order to prevent potential electrical shock to personnel working on the tank. The relocation of the power lines should be performed in accordance with the National Electric Code (NEC) guidelines.

5. **Vault:** If compliance with OSHA dimensional and safety standards is desired, the access rungs should be replaced with rungs which meet current requirements and the access modified to provide the required head clearance. The piping located in the vault should be cleaned and painted in accordance with the interior coating recommendations at the time of the tank cleaning and coating. The exposed exterior concrete surfaces should be cleaned to the equivalent of a brush-off blast cleaning and painted with a concrete sealer. Freeze protection should be provided for on all control piping and static water lines.

B. Exterior Tower and Container

1. **Life of the Exterior Coating:** The exterior coating system appeared to be in very poor condition. Tank Industry Consultants believes that the exterior of the container and tower surfaces should be painted within the year from a corrosion standpoint. Due to widespread coating failures and very poor adhesion of the remaining exterior coating, topcoating does not appear to be a feasible option.

2. **Coating Testing:** Prior to preparation of specifications for the cleaning and coating of the exterior of the tank, several samples of the exterior coating system should be subjected to laboratory analysis to test for ingredients which may at that time be subject to regulations concerning their handling and disposal.

3. **Cleaning:** Due to the fact that the present exterior coatings appear to contain lead and chromium, coating removal should be performed in accordance with local, state, and federal regulations relative to the removal of heavy-metal based coatings. When the exterior is to be cleaned, all varieties of containment should be investigated. Containment of the wind-blown debris will be required, and containment of paint droplets may be required due to the proximity of the adjacent residences.

4. **Recommended Coating System:**

a. **Complete Cleaning and Repainting:** The optimum long-life coating system presently available for this site is an epoxy-polyurethane coating system. Properly formulated and applied polyurethanes have good resistance to condensation, mildew, and chipping. The polyurethanes also have excellent color and gloss retention and the longest expected service life of any of the common exterior tank coatings. The typical life of a properly applied epoxy-polyurethane coating system is approximately 15 to 20 years. These coatings are also presently manufactured to meet current VOC requirements.

b. **Coating Application:** When the tank is to be repainted, the tank should be completely cleaned and repainted. The entire tank exterior should be cleaned to the equivalent of an SSPC-SP 6, Commercial Blast Cleaning and have an epoxy-primed, epoxy intermediate and polyurethane finish coating system applied. However, care must be taken during the application of this particular coating system because this coating does have poor dry-fall characteristics, and potential damage to the surrounding property must be taken into consideration. The polyurethane coatings also require close monitoring of temperature and humidity during application.

5. **Effective Service Life:** Tank Industry Consultants defines the life of a coating as the amount of time before repainting becomes necessary due to coating failure and corrosion. During the coating life the Owner should expect the coating to lose its gloss, start to chalk, show signs of weathering, and possibly some rust staining. Future touch-up may be required on isolated coating failures. If aesthetics are a concern, the Owner may have to topcoat the repainted tank prior to the end of the expected service life. However, future topcoating would be less expensive than complete cleaning and recoating and could delay the next complete cleaning and repainting for many years.

6. **Other Systems:** With air emission volatile organic compounds (VOC) restrictions being put in place around the nation, alternative coating systems may become available which would be viable options for this tank. The Owner should review the available systems prior to preparing specifications for the recoating project.

7. **Coating Curing:** It would be more economical to paint the tank exterior at the same time the interior is painted, since the tank must be drained while the exterior is painted, and the applied coatings cure. This will also reduce mobilization and observation costs.

8. **Rehabilitation Schedule:** To obtain the lowest possible prices for the work outlined in the recommendations, the Owner should have the specifications prepared and the work bid in the spring, with the work scheduled to start in early summer (if possible).

9. **Grinding and Bracket Removal:** Any unused brackets or erection lugs should be removed prior to the exterior repainting. Any weld burrs, weld spatter, or erection scars should be ground off to provide a smooth surface for the application of the coating.

10. **Nameplate:** The tank nameplate should be removed for the cleaning and coating of the tank. The nameplate should be cleaned and reattached to the tank using new brackets.

11. **Electrical Apparatus:** All unused electrical conduit, cable, electrical equipment, cathodic protection apparatus, and control cabinets should be removed from the tank and tank site. All required equipment should be repaired in accordance with the National Electric Code (NEC).

12. **Anchor Bolts:** After abrasive blast cleaning, the anchor bolts and nuts should then be examined for deterioration. If deterioration is found and the anchor bolts are mild steel, the deteriorated areas of the anchor bolts should be repair welded as necessary.

13. **Riser Manhole:** At the time of recoating and repairs, the gasket for the manhole should be replaced. At the time of exterior rehabilitation, the riser manhole should either be enlarged or augmented with a 30 in. diameter manhole.

14. **Riser Rods and Hand Holds:** The riser rods and the hand holds on the columns should not be used for rigging or personnel access. The ends of the rods attached to the riser through the angle stiffener should be examined for structural deterioration of the threaded ends and nuts.

15. **Exterior Ladders:** If compliance with OSHA dimensional and safety standards is desired, the exterior ladders should be replaced with ladders which meet current requirements. At the time of the exterior repainting, the safe-climbing devices should be cleaned and protected from the application of the exterior coating. Due to the amount of surface rust on the existing safe-climbing devices, replacement of the safe-climbing devices may be more economical. At a minimum, the safe-climbing devices should be cleaned and adequately installed or replaced, the revolving shell and roof ladder should be modified to a stationary ladder, the ladder rungs modified to be slip resistant, and the electrical conduit should be relocated away from the side rails.

16. **Vandal Deterrent:** The addition of a vandal deterrent with side plates would offer the Owner further protection from unauthorized access to the ladder and tank.

17. **Overflow Pipe:** The discharge end of the overflow pipe should be equipped with a new elastomeric check valve or a screened, counter-weighted flap gate to prevent the ingress of birds, small animals and insects into the tank. The welded overflow pipe brackets should be accessed following exterior cleaning and those which are found broken should be rewelded. Overflow pipes on the interior of tanks are exposed to the potential of ice damage and accelerated corrosion and metal loss rates. This results in the potential of pipe damage and an unanticipated tank draining. Therefore, Tank Industry Consultants and the AWWA Standard D100 recommend relocating the portion of the overflow pipe inside the tank to the tank exterior. The new overflow pipe section should exit the roof knuckle and connect to the existing pipe.

18. **Balcony:** Safe access from the tower ladder should be provided for through the balcony safety railing, or the existing access modified to provide adequate clearances. At the time of the exterior repairs and repainting, the balcony should be flooded and additional drain holes installed to adequately drain water from the balcony. If strict compliance with OSHA and safety-related standards is desired, the handrail should be raised to 42 in., a mid-rail installed, and the railing members replaced with dimensionally compliant members.

19. **Clog-Resistant Vent:** The tank was not equipped with a clog-resistant vent. AWWA Standards recommend that all vents with screening against insects be designed to ensure "fail-safe"

operation if the insect screens become occluded. Inadequate ventilation could cause a tank collapse if the tank is rapidly drained while the screen is occluded or frosted over. Therefore, a clog-resistant vent should be installed near the center of the roof. The vent should be designed so that it is removable in order to act as a second means of access to the tank interior. Until such time as the vent can be replaced, a more restrictive screen should be installed immediately.

20. **Additional Roof Manhole:** OSHA and safety-related standards require a second roof manhole for emergency egress during coating and repairing operations. Therefore, if a removable vent is not installed, a second roof manhole should be installed in the roof. The manhole and cover should be designed in accordance with current industry and safety standards. The new roof manhole should be installed between roof structure to allow unrestricted use of the manhole. Both the new and the existing roof manholes should be locked at all times to prevent unauthorized access to the tank interior.

21. **Roof Manhole:** The existing roof manhole should be enlarged to a 30 in. diameter manhole to provide adequate head clearance for the interior ladder. The holes in the roof adjacent to the existing roof manhole should be repaired or this section removed when the manhole is enlarged. The roof manhole and cover should continue to be locked to improve water system security.

22. **Cathodic Protection Hand Holes:** If a hanging anode system will not be used in the future, then the openings should be welded shut when repainting the tank.

23. **Obstruction Lights:** The Owner should file a FAA Form 7460 to verify the need for obstruction lighting on the tank. If the lighting is required, new bulbs should be installed and the existing light repaired, or the obstruction light replaced. When the obstruction light is repaired or replaced, the exposed wiring should be covered and the conduit should be located so as not to interfere with the ladder side rails. The obstruction light will need to be relocated when the roof vent is replaced.

C. Interior Surfaces

1. **Life of the Interior Coating:** Due to the significant amount of rust in the roof structure and the few severe pits observed in the bowl, Tank Industry Consultants recommends that the interior surfaces of this tank should be recoated within the year. It is recommended that when the interior is completely cleaned and repainted, an epoxy coating system should be used.

2. **Coating Testing:** Prior to preparation of specifications for the cleaning and coating of the interior of the tank, several samples of the interior coating system should be subjected to laboratory analysis to test for ingredients which may at that time be subject to regulations concerning their handling and disposal.

3. Recommended Interior Coating System:

a. **Epoxy Coating System:** The optimum long-life coating system presently available for the interior of water tanks is a two-component epoxy coating system. A three-coat epoxy system is recommended for the interior of this tank. This coating system should meet the certification criteria of ANSI/NSF 61 and state department of health regulations.

c. **Service Life:** The typical life of a properly formulated and applied epoxy coating system is approximately 12 to 15 years in immersion service. Tank Industry Consultants defines the life of a coating as the expected service life before repainting becomes necessary due to coating failure and corrosion. The Owner could extend the service life of the coating by installing, properly maintaining and operating a cathodic protection system to help protect the steel surfaces in areas which have experienced coating failure.

- a. **Type:** When the cathodic protection system is installed, an ice-resistant cathodic protection system which features long-life anodes, automatic potential and current control, with an independently controlled circuit and anode for the riser should be specified.

c. **Maintenance:** Cathodic protection, if used and maintained properly, will control active corrosion below the water level and extend the useful life of a coating system. It should be noted that maintenance as recommended by the cathodic protection manufacturer is required for the cathodic protection system to work properly. Without proper monitoring, the cathodic protection system may operate too high and cause the coating to blister, or the system may operate too low and not adequately protect the exposed steel surfaces.

6. **Pit Welding and Pit Filling:** After initial cleaning, all significant pitting which is found should be welded, and all pitting with rough edges that would make the pitting difficult to coat properly should be filled with a solventless epoxy seam sealer.

7. **Seam Sealing:** The existing roof manhole, interior shell stiffener, column stiffeners on the shell, and existing roof vent intersections should be sealed with an epoxy seam sealer at the time of the interior recoating.

8. **Flexible Sealant:** The roof stiffener-to-roof interface, and the unwelded lapped roof seams should be sealed with a flexible sealant at the time of the interior recoating.

9. **Rough Edges:** All unused brackets should be removed from the interior and exterior surfaces at the time of the next recoating. Any weld burrs, spatter, scars or rough edges in the steel should be ground smooth to provide a better surface for coating.

10. **Interior Ladder:** Interior ladders may be susceptible to ice damage and corrosion. If the Owner decides to keep the interior ladder, the ladder should be replaced by a ladder which complies with current industry standards and should be equipped with a corrosion-resistant safe-climbing device. **Due to the significant corrosion and metal loss on the existing interior container ladder, personnel should not use the existing interior container ladder for access.**

11. **Riser-to-Bowl Connection:** A thick ring was located in the bowl at the top of the riser. This type of thick ring is very inflexible and produces areas of high stress on the adjacent bowl saucer plate. This high stress concentration leads to increased corrosion rates known as stress corrosion. Stress corrosion in the form of pitting around the riser wall connection to the stiffening ring had occurred. When the tank is rehabilitated, the pitting in this area should be repaired by welding. Traditionally joint configurations similar to this one have developed leaks at these high stress locations. To help prevent the possibility of future leaks, Tank Industry Consultants recommends that the stiffening ring joint be regularly inspected in the future to determine if the joint should be replaced with a more flexible joint to help reduce the stress corrosion in this area.

12. **Riser Safety Grate:** The existing hinged safety grate should be replaced with a safety grate with only a section of the grate hinged as an access opening to offer further coverage of the opening and further protection to personnel in the bowl while the riser is being accessed.

13. **Protective Cover:** The inlet/outlet pipe should be equipped with a protective cover to deflect foreign objects from the pipe, in accordance with AWWA D100.

14. **Lead Joint Removal:** The suspected lead joint at the inlet/outlet pipe-to-riser floor penetration should be verified and removed or isolated from contact with the water.

ECONOMIC FACTORS:

<u>Item</u>	<u>Cost</u>	<u>Life in Years</u>
Replacement of tank with a new one	\$950,000 ¹	75+

The following is a complete list of repairs and estimated costs for their respective recommendations found in the RECOMMENDATION section of this report.

Item	Sanitary & Safety	Scheduled Maintenance Repairs
Clean and Paint Exterior:		
SP 6, Complete Clean, Epoxy/Polyurethane System		\$ 170,000
Containment		80,000
² Heavy Metal Abatement & Disposal		35,000
Clean and Paint Interior:		
SP 10, 3-Coat Epoxy System		140,000
² Heavy Metal Abatement & Disposal		30,000
Cathodic Protection System		10,000
Miscellaneous Chipping and Grinding		6,000
Seam Sealing		4,000
Pit Repair		4,000
Foundation Repair		8,000
Roof Structure Repairs		30,000
Roof Structure Bolts		6,000
Overflow Pipe Modifications	\$ 5,000	
Riser-to-Bowl Connection Modification	15,000	
Interior Container Ladder Removal	1,000	
Interior Container Ladder Replacement	4,000	
Interior Container Ladder Safe-Climbing Device	2,000	
Exterior Ladders Replacement	14,000	
Exterior Ladder Safe-Climbing Devices	6,000	
Vandal Deterrent	2,000	
Balcony Safety Railing Modifications	22,000	
Enlarge Roof Manhole	5,000	
Additional Roof Manhole	5,000	
Removable Clog-Resistant Vent	6,000	
Existing Vent Modifications	1,000	
Inlet/Outlet Pipe Protective Cover	2,000	
30 in. Diameter Riser Manhole	6,000	
Riser Safety Grate	4,000	
Contingency Items	5,000	7,000

Estimates are believed to be a high average of bids that would be received in 2004.

¹ The replacement estimate includes costs associated with new tank fabrication and erection, foundation, painting, and engineering. The budget estimate given does not include costs associated with tank demolition, site acquisition, and distribution interruptions.

² Heavy metal abatement is included in the economic factors; however, the hazardous disposal will not be required unless the abrasive residue is determined to be hazardous.

The following economic factors include only those work items which the Engineer believes to be the minimum to properly maintain this tank from an operational standpoint. Other items related to safety and risk management should be evaluated by the Owner.

Item	Cost
Clean and Paint Exterior:	
SP 6, Complete Clean, Epoxy/Polyurethane System	\$ 170,000
Containment	80,000
² Heavy Metal Abatement & Disposal	35,000
Clean and Paint Interior:	
SP 10, 3-Coat Epoxy System	140,000
² Heavy Metal Abatement & Disposal	30,000
Miscellaneous Chipping and Grinding	6,000
Seam Sealing	4,000
Pit Repair	4,000
Foundation Repair	8,000
Roof Structure Repairs	30,000
Roof Structure Bolts	6,000
Overflow Pipe Modifications	5,000
Riser-to-Bowl Connection Modification	15,000
Interior Container Ladder Replacement	4,000
Interior Container Ladder Safe-Climbing Device	2,000
Exterior Ladders Replacement	14,000
Exterior Ladder Safe-Climbing Devices	6,000
Vandal Deterrent	2,000
Balcony Safety Railing Modifications	22,000
Enlarge Roof Manhole	5,000
Removable Clog-Resistant Vent	6,000
Inlet/Outlet Pipe Protective Cover	2,000
30 in. Diameter Riser Manhole	6,000
Riser Safety Grate	4,000
Contingency Items	12,000
Total of Engineer's Recommendations	\$ 618,000

Tank Industry Consultants has no control over the cost of labor, materials, or equipment, or over the contractors' methods of determining prices, or over competitive bidding, or the market conditions. Opinions of probable cost, as provided for herein, are to be made on the basis of our experience and qualifications and represent our best judgment as design professionals familiar with the design, maintenance, and construction of concrete and steel plate structures. However, Tank Industry Consultants cannot and does not guarantee that proposals, bids, or the construction cost will not vary from opinions of probable cost prepared for the Owner.

Due to the numerous potential scopes of work which exist, the Owner should obtain an updated budget estimate once the final scope of work has been determined. This would enable the Owner to accurately budget monies for additional mobilization costs and damaged coating rehabilitation costs.

Engineering and resident observation costs are not included in the Total of the Engineer's Recommendations because these fees are dependent upon the scope of work to be performed. Tank Industry Consultants performs all facets of the engineering services which would be required for this project. Estimated fees for engineering and resident observation will be furnished upon request.

CLOSURE:

Brief Summation: The City of Brazil has a 750,000 gallon elevated water storage tank which, with the exception of isolated pitting in the bowl and corrosion on the roof trusses, was in fair overall condition and may serve the community for years to come if rehabilitated and maintained. Proper maintenance after completing the recommendations herein would include periodic washouts and evaluations approximately every 3 years, and the future installation and proper maintenance of a new ice-resistant cathodic protection system with long-life anodes.

Contractor Selection: The work should be performed by a competent bonded contractor, chosen from competitive bids taken on complete and concise specifications. The coatings used should be furnished by an experienced water tank coating manufacturer, supplying the field service required for application of technical coatings.

Standards for Repairs and Coatings: All work done and coatings applied should be applied in accordance with ANSI/NSF Standard 61, the manufacturer's recommendation, AWWA D100 and AWWA D102 (latest revisions), and the SSPC: The Society for Protective Coatings.

Observation of Work: Observation of the work in progress by experienced personnel will offer additional assurance of quality protective coating application. Observations can be performed on a continuous basis or spot (critical phase) basis. The actual cost of observation may be less using spot as opposed to full-time resident observation; however, with spot observation it is often necessary for work to be redone to comply with the specifications. This somewhat lowers the quality of the finished product, lengthens the job, and is frequently a cause of conflict between the contractor, Owner, and field technician. Resident full-time observation minimizes the amount of "rework" required.

Anniversary and Maintenance Evaluations: An anniversary evaluation should be conducted prior to the end of the one year bonded guarantee. Washouts and coating, structural, sanitary, safety, and corrosion evaluations should be conducted not less than every three years.

Time Frame: If the work is not performed within the next 6 to 12 months, the structure should be reevaluated prior to the preparation of specifications and solicitation of bids.

Specifications and Bidding Documents: The recommendations in this report are not intended to be specifications on which a contractor can bid. Complete bidding documents must include general and special conditions, detailed technical specifications, and other information necessary for the competitive bidding process. To properly protect the interests of the Owner, Contractor, and Engineer; the initial evaluation, the technical specifications, legal portions of the contract documents, and the observation should be performed by the same firm or with close coordination of all parties involved.

Limitations of Evaluation: It is believed that the conditions reported herein reflect the condition of the tank as observed on the date of the evaluation, using reasonable care in making the observations, and safety in gaining access to the tank. Should latent defects be discovered during the cleaning of the structure, they should be brought to the attention of the Owner and the Engineer.

Seismic and Wind Loadings: This tank is located in or near a Zone 1 (AWWA D100-96) earthquake region. This evaluation and the reporting of the condition of this tank do not warrant the structural condition of the tank or any of the original design for seismic loadings. Likewise, recommendations for this tank do not include modifications that may be required for compliance with present structural codes. It is possible the tank was erected in compliance with pre-existing industry standards which have since been replaced by more restrictive standards.

Hazardous Materials in Coatings: Samples taken of the coatings on the exterior and interior of this structure indicated a presence of lead, chromium, and possible other heavy-metal pigments. It should be taken into consideration that Federal, State, and local environmental agencies have placed stricter controls on the removal of lead-based and other heavy-metal based coatings from steel structures by the use of conventional abrasive blasting techniques. The paint and blast residue may be considered to be hazardous waste depending on the concentration of lead or other particles in residue.

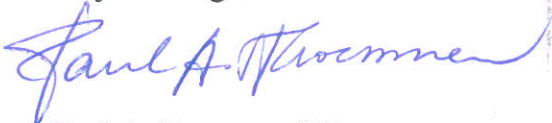
Please contact Tank Industry Consultants if you have any questions or comments.

Respectfully submitted,

Tank Industry Consultants



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Project Designer



Paul A. Troemner, P.E.
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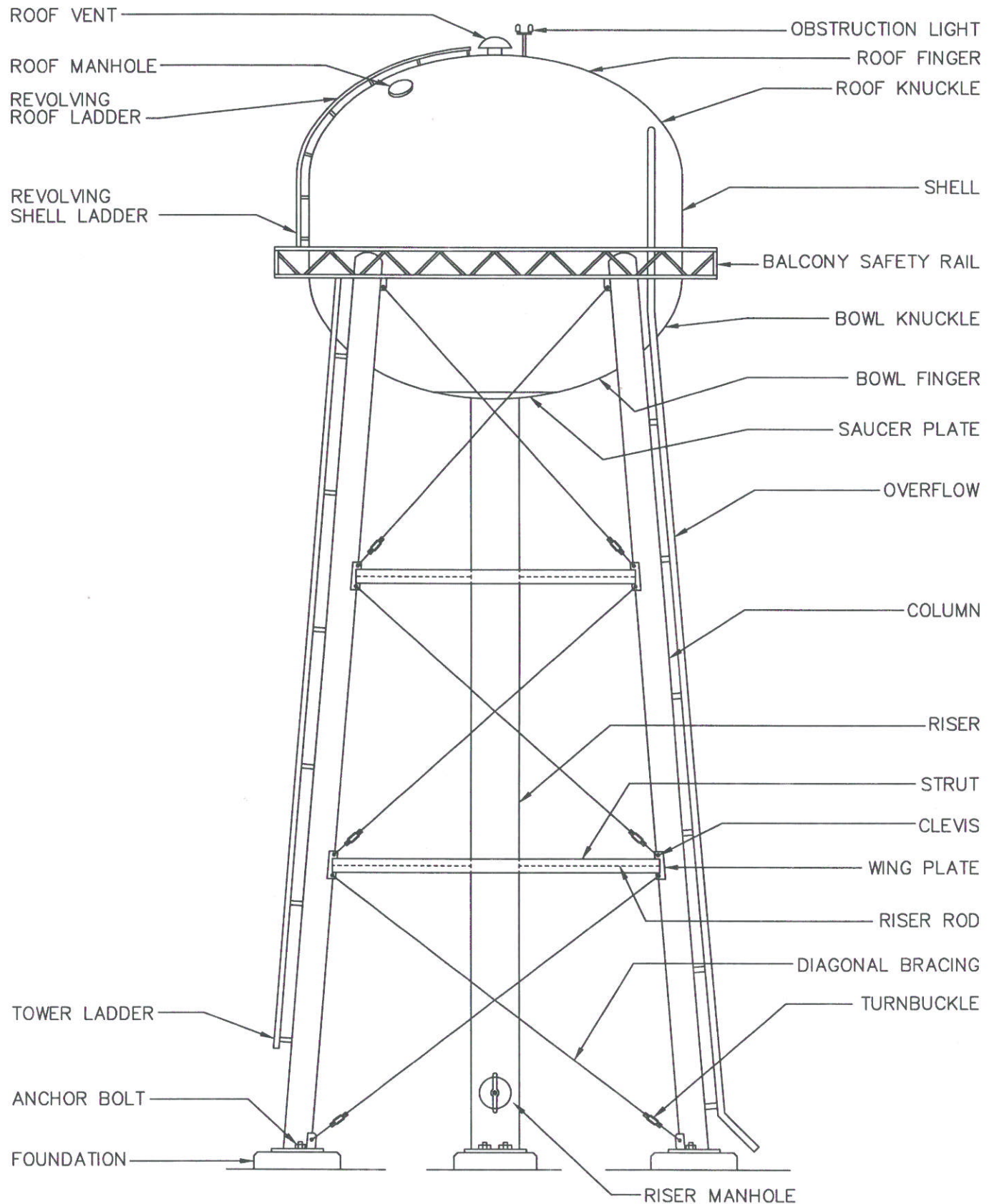


Gregory R. "Chip" Stein, P.E.
Vice President

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DOUBLE ELLIPSOIDAL TANK



NOMENCLATURE

Classification of Adhesion Test Results

Method A — X Cut Tape Test Approx. 1.5 in. long cuts at 30 deg. to 45 deg. apart.	Surface	Classification
No peeling or removal.		5
Trace peeling or removal along incisions.		4
Jagged removal along incisions up to 1/16 in. (1.6mm) on either side.		3
Jagged removal along most of incisions up to 1/8 in. (3.2mm) on either side.		2
Removal from most of the area of the X under the tape.		1
Removal beyond the area of the X.		0

Method B — Lattice Cut Tape Test Six parallel cuts at 2mm apart.	Surface	Classification
The edges of the cuts are completely smooth; none of the squares of the lattice are detached.	No Failure	5
Small flakes of the coating are detached at intersections; less than 5% of the lattice is affected.		4
Small flakes of the coating are detached along edges and at intersections of cuts. The area affected is 5% to 15% of the lattice.		3
The coating has flaked along the edges and on parts of the squares. The area affected is 15% to 35% of the lattice.		2
The coating has flaked along the edges of cuts in large ribbons and whole squares have detached. The area affected is 35% to 65% of the lattice.		1
Flaking and detachment worse than grade 1.		0

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FAX — 317/271-3300

CERTIFICATE OF ANALYSIS

Tank Industry Consultants
7740 West New York Street
Indianapolis, IN 46214

Attn: Julie Perkins
Invoice Number:

Order #: 04-03-869
Date: 03/26/04 14:06
Work ID: H969.01 Paint Samples
Date Received: 03/23/04
Date Completed: 03/26/04
Client Code: TANK_INDUST

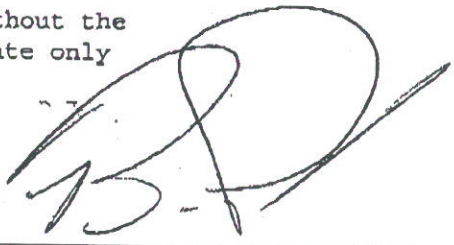
SAMPLE IDENTIFICATION

<u>Sample Number</u>	<u>Sample Description</u>
01	H969.01 Int. Bowl

<u>Sample Number</u>	<u>Sample Description</u>
02	H969.01 Ext. Bowl

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This report contains a total number of pages: 02



Certified By
Lab Manager

ESG Laboratories

ENVIRONMENTAL SERVICES
5933 WEST 71ST STREET INDIANAPOLIS, INDIANA 46278
A Member of THE ASTRIURY GROUP

PHONE (317) 290-1471
FAX (317) 290-1670



Order # 04-03-869
03/26/04 14:06

TEST RESULTS BY SAMPLE

Page 2

Sample: 01AR H969.01 Int. Bowl

Collected: 03/23/04 Category: PAINT_CHIPS

<u>Test Description</u>	<u>Result</u>	<u>Limit</u>	<u>Units</u>	<u>Analyzed</u>	<u>By</u>
Cadmium, ICP-AES	<25.00	25.00	mg/kg	03/26/04	KF
Chromium, ICP-AES	2600.000	250.000	mg/kg	03/26/04	KF
Lead, ICP-AES	42500.000	400.000	mg/kg	03/26/04	KF

Sample: 02AR H969.01 Ext. Bowl

Collected: 03/23/04 Category: PAINT_CHIPS

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Cadmium, ICP-AES	<25.00	25.00	mg/kg	03/26/04	KF
Chromium, ICP-AES	399.000	250.000	mg/kg	03/26/04	KF
Lead, ICP-AES	26500.000	400.000	mg/kg	03/26/04	KF

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750,000 Gallon
Steel Elevated Tank
City of Brazil, Indiana

1. Tank and site.



2. Tank and site.



3. Surrounding area.



4. Surrounding area.



5. Surrounding area.



6. Surrounding area.



7. Tank site.



8. Site entrance.



9. Access to vault.



10. Inlet/outlet pipe with tap for telemetry inside vault.



11. Column foundation, base plate, and anchor bolt. Note cracks and chipped section of concrete.



12. Column foundation, base plate, and anchor bolt. Note crack in concrete and rust on base plate and anchor bolt.



13. Riser, foundation, base plate, and anchor bolts. Note cracks in cap on foundation, and note welded steel patch plate and hose bib in bottom of riser.



14. Sludge removed from tank interior.



15. Riser, manhole, tank nameplate, and adjacent building. Note coating failures and corrosion on riser.



16. Telemetry cabinet and heater inside building adjacent to riser.



17. Overflow pipe discharge into drain basin.



18. Overflow pipe along column. Note sign on column and rust on bowl and riser.



19. Coating failures and rust on column.



20. Coating failures and rust on plate around bottom of column. Note conduit.



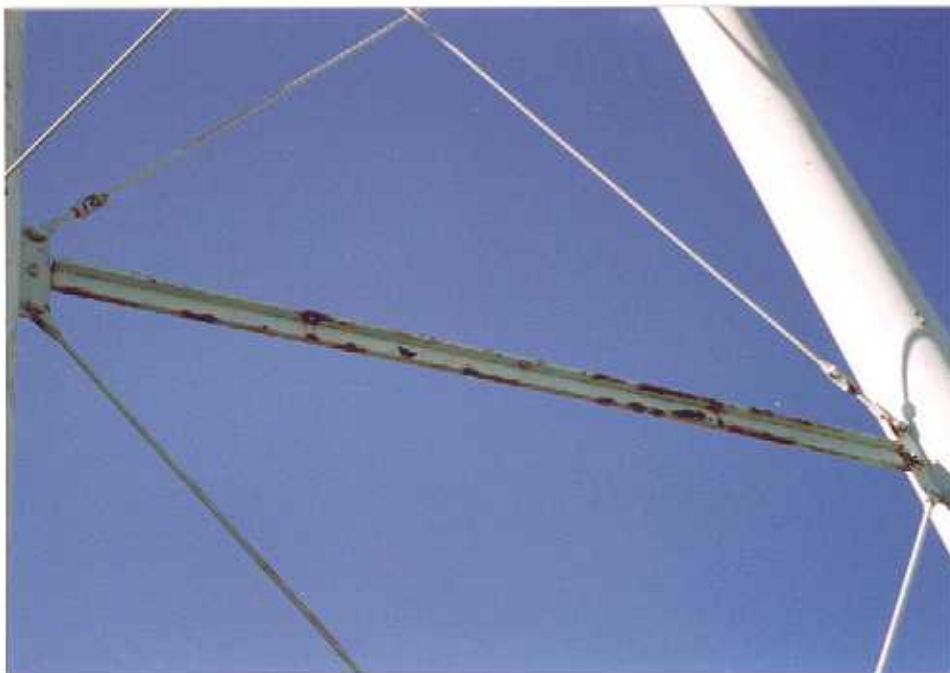
21. Cathodic protection rectifier on column.



22. Column, struts, diagonal bracing, and bowl. Note rust.



23. Columns, struts, diagonal bracing, and bowl.



24. Rust along underside of strut.



25. Rust along strut.



26. Rust inside strut channel.



27. Rust at diagonal bracing clevis connection to wing plate on column.



28. Coating failures, rust, and rust staining on riser and riser rods.



29. Coating failures, rust, and rust staining on riser and riser rods. Note overhead electrical line for telemetry building adjacent to riser.



30. Coating failures and rust on riser and bowl.



31. Container, ladders, and balcony. Note signs on tank shell and columns.



32. Signs on container and columns. Note widespread rust.



33. Photoelectric cell and brackets below tower ladder.



34. Tower ladder.



35. Underside of balcony.



36. Tower ladder access to balcony. Note rust on safe-climbing device and conduit and cable along ladder side rail.



37. Tower ladder above balcony. Note conduit and cable.



38. Rust on balcony floor.



39. Rust on balcony floor and chalked coating on shell.



40. Faded sign on container.



41. Scratches in coating from wheels of revolving shell and roof ladder. Note misspelling of "PROGRESS."



42. Sign on container.



43. Chalked coating exposed underlying coating on roof knuckle.



44. Coating failures and rust on roof.



45. Coating failures and rust on roof.



46. Roof manhole. Note corrosion on manhole curb and interior ladder and holes in roof adjacent to manhole.



47. Shell and roof ladder.
Note rust on safe-climbing device and conduit and cable along ladder side rail.



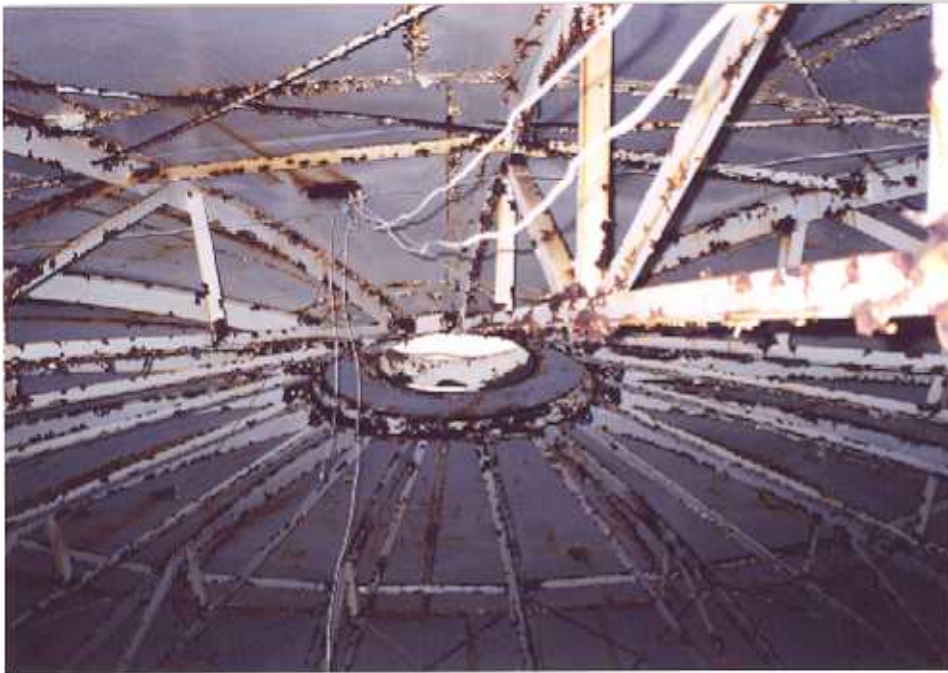
48. Roof vent, obstruction light, and antenna mounting bracket.



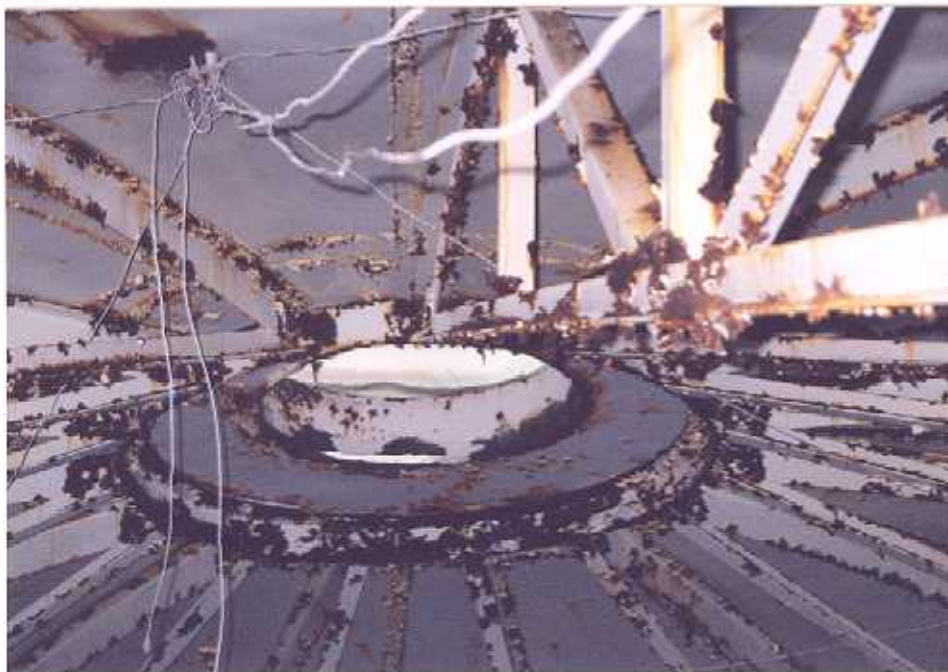
49. Roof vent screen.



50. Roof vent cover, obstruction light, and antenna mounting bracket.



51. Interior roof structure and cathodic protection wiring. Note rust on roof and trusses.



52. Vent opening, interior roof structure and cathodic protection wiring. Note rust on roof and trusses.



53. Interior roof structure.



54. Peeled coating and corrosion on roof and along truss members.



55. Interior roof structure.



56. Corrosion along roof truss member.



57. Corrosion along roof truss member.



58. Corrosion at connection of roof truss members.



59. Roof truss connection
at top of roof knuckle.



60. Corrosion along
lapped seam of roof
plates.



61. Peeled coating adjacent to roof stiffener.



62. Peeled coating and rust adjacent to roof stiffener.



63. Roof stiffener connection to stiffener at top of shell.



64. Interior roof and shell.



65. Overflow pipe weir box.



66. Interior roof, shell, overflow pipe, and weir box.



67. Corrosion on interior of roof manhole curb.



68. Corrosion and metal loss on interior container ladder below roof manhole.



69. Interior container ladder.



70. Corrosion and metal loss on interior container ladder at bowl.



- 71. Corrosion and metal loss on interior container ladder at bowl.



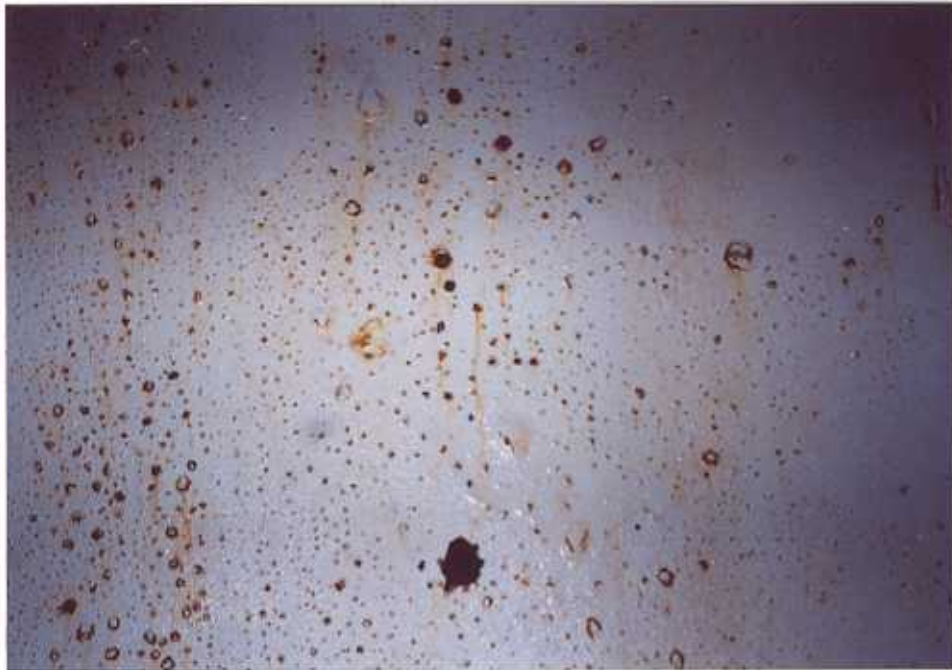
- 72. Interior roof, shell, and bowl. Note column stiffener and circular patch plate in shell.



73. Interior bowl and riser safety grate.



74. Weld burrs on interior bowl.



75. Blisters in coating on bowl.



76. Coating failures on bowl.



77. Interior bowl and riser opening with safety grate. Note pitted areas on bowl around riser opening.



78. Pit in bowl.



79. Pit in bowl.



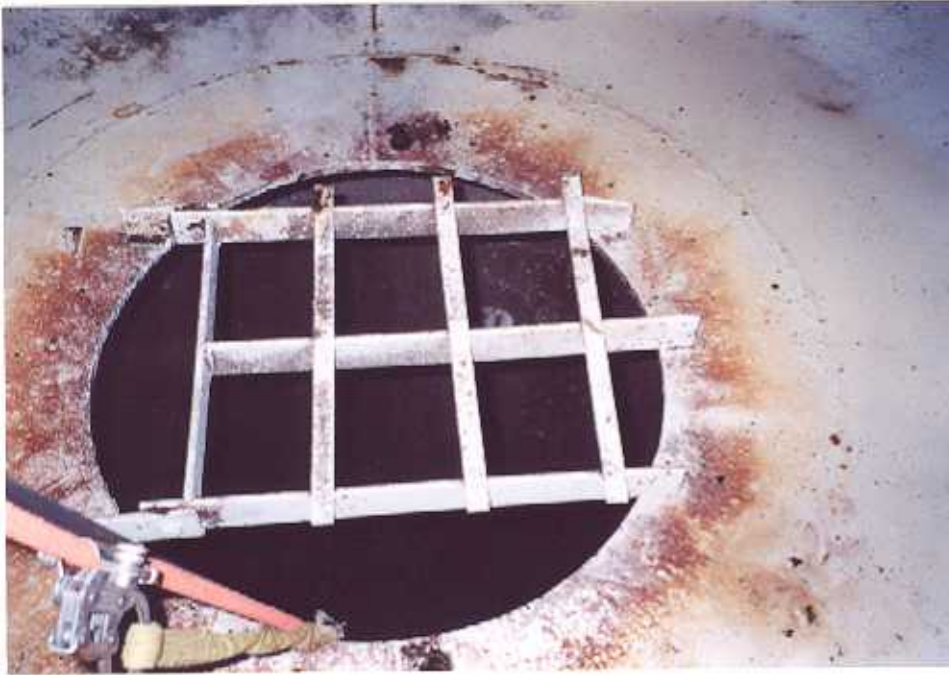
80. Pits in bowl.



81. Pit in bowl.



82. Pits in bowl.



83. Riser safety grate.



84. Bracket on interior riser.



85. Bracket on interior riser.



86. Interior riser.



87. Bracket at riser floor.



88. Blisters in coating on riser floor.



89. Inlet/outlet pipe at bottom of riser.



90. Inlet/outlet pipe at bottom of riser.